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AUTHOR Gottlieb, Michael C.; Dickey, Diane F.
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ABSTRACT

To investigate the effect of mirror-image and aligned relative positions with learning disabled (LD) children, and to explore the development of orientation ability in both LD and normal children, 30 LD and 30 normal Ss (6- and 8-years old) were given a task in which they were required to match their "horseshoe" to that of the examiner. Twenty-four random presentations consisted of eight combinations of up-down or left-right orientations in mirror-image or aligned relative positions. Findings indicated that mirror-image relative position was significantly more difficult for all Ss than the aligned position, and that LD Ss made significantly more errors than normal Ss. No difference was found between 6-year-old LD and normal Ss, but 8-year-old LD Ss made significantly more errors than 8-year-old normal Ss. (Author/LS)

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Spatial Orientation Ability in Learning Disabled Children

Effects of Plane and Relative Position

Michael C. Gottlieb

Southern Methodist University

Diane F. Dickey

Travis State School

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Running head: Spatial Orientation Ability in Learning Disabled Children

Abstract

Thirty learning disabled and thirty normal children were given a task in which they were required to match their "horseshoe" to that of the examiner. Twenty-four random presentations consisted of eight combinations of up-down or left-right orientations in mirror-image or aligned relative positions. Analysis of variance indicated that mirror-image relative position was significantly more difficult for all subjects than the aligned position, F (1, 59) = 11.57, $p < .01$. Chi square analysis showed that learning disabled subjects made significantly more errors than normal subjects, $X^2 = 8.0$, $p < .01$. No difference was found between six year-old learning disabled and normal subjects, but eight year-old learning disabled subjects made significantly more errors than eight year-old normal subjects, $X^2 = 7.0$, $p < .01$.

Spatial Orientation Ability in Learning Disabled Children: Effects of Plane and Relative Position

Among the characteristics of many learning disabled children is the tendency to mirror-image letters and/or figures. This confusion of spatial orientation is manifested in reversals or rotations (letters, numbers, or words) in reading, writing, and/or spelling.

Considerable evidence suggests that up-down discriminations are easier to make than left-right discriminations. Thus, reversals along the horizontal axis tend to occur less frequently and to disappear earlier than those along the vertical axis (Benton, 1959; Rudel & Teuber, 1963; Benson, 1970).

For example, Rudel and Teuber (1963) found that children were more consistent in choosing a particular orientation from the figures ⌐⌐ or ⌐⌐ than from ⊏⊐ or ⊐⊏ . The authors attributed this difference in difficulty to plane, i.e. the direction (left-right or up-down) that the horseshoe-shaped figure opens and concluded that up-down discriminations were easier than left-right.

In the first of two studies, Janellan Huttenlocher (1967 a) noted that the figures in Rudel and Teuber's (1963) discrimination task differed not only in plane, but also in relative position, i.e., the relationship of a figure to an adjacent figure. In Rudel and Teuber's (1963) up-down pairs

(⌐¬ and ⌐¬), rotating ⌐ or ¬ around the axis of separation between the two figures produces the identical orientation, i.e., ¬ becomes ¬ , and ⌐ becomes ⌐ . However, in the left-right pairs (⌐⌐ and ⌐¬) ⌐ may be rotated around the axis of separation to produce ⌐ , its mirror-image. Likewise, ⌐ can be rotated around the axis of separation to produce its mirror-image ¬ . Thus, Huttenlocher (1967 a) concluded that Rudel and Teuber (1963) may have unknowingly made up-down discriminations easier for subjects than left-right by ignoring the relative positions of the figures (Huttenlocher, 1967 a).

To avoid this problem, Huttenlocher (1967 a) presented the Rudel and Teuber (1963) arrays so that the up-down problems were presented ⌐¬ or ⌐¬ and the left-right problems were presented ⌐¬ or ⌐¬ . Huttenlocher (1967 a) found that left-right discriminations were easier than up-down problems, the opposite of Rudel and Teuber's (1963) findings.

In Huttenlocher's second study (1967 b), she investigated the combined effect of relative position and plane. Her subjects were normal four year-old children. The apparatus was a board partitioned into two sections in which fit two square horseshoes. The child was asked to match the experimenter's horseshoe in each of eight different orientations (Figure 1).

Insert Figure 1 about here

As may be seen, half of the problems open to the left or right, and half up or down demonstrating the concept of plane.

The presentations also differ in relative position for both left-right and up-down. Huttenlocher (1967 b) has called these two positions: (a) "Aligned" relative position: where a rotation of the sample about the axis of separation would not produce a mirror-image, and (b) "Mirror-image" relative position: where a rotation of the sample about the axis of separation would create a mirror-image, and thus, an error.

Huttenlocher recorded results as total number of errors and number of children making such errors (See Table 1).

Insert Table 1 about here

She concluded that relative position had an important effect on children's ability to orient objects, since mirror-image was considerably more difficult than aligned. Huttenlocher (1967 b) further concluded that children who have a constant tendency to mirror image would have no trouble reproducing the horseshoes in the aligned relative position, but would make a considerable number of errors in the mirror-image relative position. Unfortunately, Huttenlocher (1967 b) performed no statistical tests to substantiate her conclusions.

Hypotheses

The first purpose of the study was to investigate the effect of mirror-image and aligned relative positions with learning

disabled children. The second purpose was to explore the development of orientation ability in both learning disabled and normal groups of children.

It was specifically hypothesized that: (1) Normal children will make more correct matches to the sample than learning disabled children. (2) Older children will make more correct matches than younger children. (3) All children will make more correct matches in the aligned relative position than they will in the mirror-image relative position.

Method

Subjects

A total of 60 male children, 30 learning disabled and 30 normal, were obtained from local Dallas schools. Fifty-five boys were Caucasian, and 5 were Black.

To investigate the developmental aspect of orientation ability, two age groups were used. Six years was selected as the lower age level due to the difficulty in diagnosing learning disabilities before a child enters school. Eight years was chosen as the upper age level because it was cited most often in the literature as the age at which normal children overcome reversal tendencies.

Both learning disabled and normal groups contained 15 boys whose ages ranged from 6-0 to 6-11 and 15 boys whose ages ranged from 8-0 to 8-11.

Apparatus

The apparatus used was built to Huttenlocher's (1967 b)

specifications, with minor alterations in dimensions. A board 12.7cm X 24.13cm was partitioned into two sections 9.8425cm square and served as the frame. Two wooden horseshoes designed to fit into the sections of the frame were 1.525cm square, 1.27cm wide and 1.27cm thick. The frame was painted white and the horseshoes were black (Figure 2).

Insert Figure 2 about here

Procedure

Each child was given twenty-four presentations in which he was asked to match the experimenter's sample which was left in place. There were three trials for each of Huttenlocher's eight orientations (Figure 1).

The child and the experimenter sat side by side. The experimenter always put his horseshoe in the rear section or the left section, depending on the orientation of the frame. The subject was told to put his horseshoe into his section "in exactly the same way as the other one" (Huttenlocher, 1967 b). Rearrangement of the frame by the experimenter on each trial was screened from the subject and the order of the twenty-four presentations varied randomly across subjects. The subject was not given information as to his success or failure, but was allowed to change the position his horseshoe as many times as he wished.

Results and Discussion

Analysis of variance yielded no significant difference

between the learning disabled and normal subjects (Table 2).

Insert Table 2 about here

There was also no difference between the six year-old and eight year-old subjects. Thus, hypotheses 1 and 2 were not supported. However, significantly more correct matches were made in the aligned relative position than in the mirror-image relative position, and hypotheses 3 was supported (F (1,59)= 11.57, $p < .01$).

Visual inspection of the data revealed that approximately half of the subjects were responsible for the incorrect matches. Therefore, Chi square one-sample tests were used to compare (1) the total number of errors made, (2) the number of children making one or more errors, and (3) the total number of mirror-image relative position errors. The results of these analyses may be found in Table 3.

Insert Table 3 about here

The results from all statistical tests supported the hypothesis that mirror-image relative position was significantly more difficult for all children than the aligned relative position: $X^2=35.2$, $p < .001$ and $X^2=16.40$, $p < .001$. Such a finding was consistent with Huttenlocher's (1967 b) results.

Huttenlocher (1967 b) also showed that left-right orientation errors were more common than up-down errors. However, she performed no statistical analysis on her data to support this conclusion. The

present study found no significant difference in total number of errors or number of children making errors between up-down and left-right orientation. Although not statistically significant, forty-one up-down errors were made compared to thirty left-right errors, a trend opposite that reported by Huttenlocher (1967 b). This finding was consistent however with that of Kersner (1971). Therefore, it was concluded that when relative position is taken into account, there is no difference in difficulty between up-down and left-right orientations.

The results of the present study tentatively suggest that learning disabled children found the task more difficult to accomplish than normal children. The analysis of variance revealed that differences between learning disabled and normal subjects approached significance at the .25 level. The Chi-square statistic for number of errors made resulted in a difference between the two groups at a .01 level of significance. Even though there was no difference between the absolute number of learning disabled and normal children who made errors, those learning disabled subjects who did make errors made considerably more errors than the normal subjects. The lack of difference in number of children making errors was most likely due to the heterogeneity of the class of children known as learning disabled (Bannatyne, 1971). The fact that the learning disabled subjects did make more errors, however, was consistent with previous research findings (Benton, 1962).

One of the more interesting results of the present study was that the six year-old learning disabled subjects made exactly the same number of errors (24) as the six year-old normal subjects. The eight year-old learning disabled subjects, however, made significantly ($p<.01$) more errors than the eight year-old normal subjects. The first result can be explained by previous studies which showed that all children, when first learning to read and write, experience reversals (Davidson, 1935; Ilg & Ames, 1950; Gibson, et. al., 1962; McClurg, 1969; Benson, 1970). Thus, at age six learning disabled children have not fallen behind normal children with respect to making reversals. However, by the time the learning disabled child reaches eight years-old, the effect of his handicap is clearly visible.

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Notes

The present study was in partial fulfillment of the requirements for the M.A. degree by the second author under the direction of the first. Requests for reprints may be sent to: Michael C. Gottlieb, 209 Clements Hall, Southern Methodist University, Dallas, Texas 75275.

Table 1

Results: Huttenlocher (1967 b)

	Up-Down Aligned	Left-Right Aligned	Up-Down Mirror-Image	Left-Right Mirror-Image
(1) Total Number of Errors:				
	0	4	21	37
(2) Number of Children Making Errors:				
	0	4	12	19

Table 2

Analysis of Variance

Source	SS	df	MS	F	Level of Significance
Between Subjects	158.492	59			
Experimental Group (A)	4.408	1	4.408	1.613	.25
Age (B)	.675	1	.675	.247	NS
A x B	.409	1	.409	.149	NS
Error Between	153.000	56	2.732		
Within Subjects	130.500	60			
Relative Position (C)	21.675	1	21.675	11.578	.01
A x C	.075	1	.075	.040	NS
B x C	3.675	1	3.675	1.963	NS
A x B x C	.208	1	.208	.111	NS
Error Within	104.867	56	1.872		
Total	288.992	119			

Table 3

Results of Chi Square One-Sample Tests

(1) Total Number of Errors Made

Comparison	Chi Square Value	Level of Significance*
1. Learning Disabled x Normal	8.0	.01
2. 6 year-olds x 8 year-olds	0.4	NS
3. Mirror-image Relative Position x Aligned	35.2	.001
4. 6 year-old L.D.'s x 8 year-old L.D.'s	0	NS
5. 6 year-old N.'s x 8 year-old N.'s	1.4	NS
6. 6 year-old L.D.'s x 6 year-old N.'s	1.6	NS
7. 8 year-old L.D.'s x 8 year-old N.'s	7.0	.01
8. Up-Down Orientation x Left-Right	1.4	NS

(2) Number of Children Making One or More Errors

Comparison	Chi Square Value	Level of Significance
1. Learning Disabled x Normal	.78	NS
2. 6 year-olds x 8 year-olds	.78	NS
3. Mirror-image Relative Position x Aligned	16.40	.001
4. 6 year-old L.D.'s x 8 year-old L.D.'s	0	NS
5. 6 year-old N.'s x 8 year-old N.'s	1.22	NS
6. 6 year-old L.D.'s x 6 year-old N.'s	0	NS
7. 8 year-old L.D.'s x 8 year-old N.'s	1.22	NS
8. Up-Down Orientation x Left-Right	.78	NS

(3) Total Number of Mirror-Image Relative Position Errors

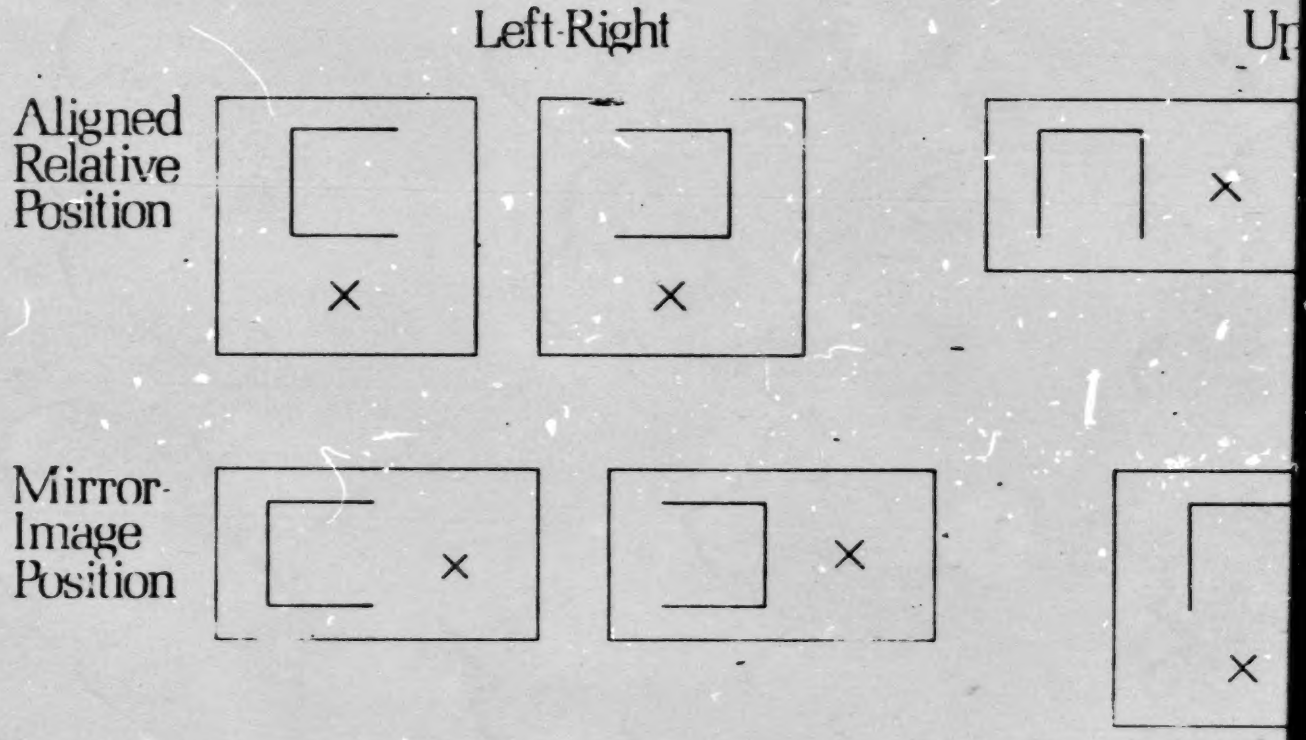
Comparison	Chi Square Value	Level of Significance*
1. Learning Disabled x Normal	3.21	.10

*alpha unadjusted for multiple comparisons

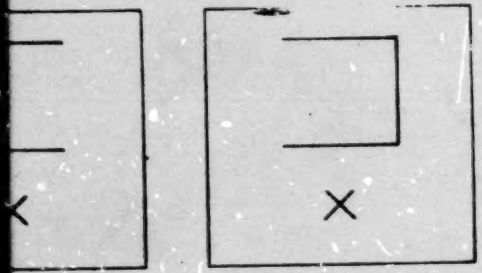
Figure Captions

Figure 1. Combined effect of relative position and plane

Figure 2. Apparatus (after Huttenlocher, 1967b)

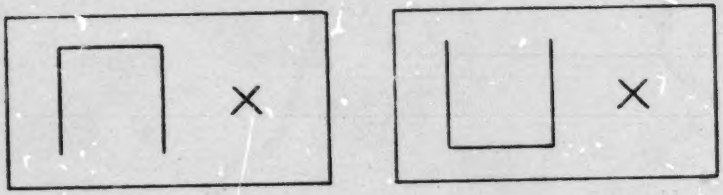

Left-Right
Aligned Relative Position
Mirror-Image Position

Left-Right



19

Up-Down



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